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Historical Trends in the U. S. Cost of Capital

by

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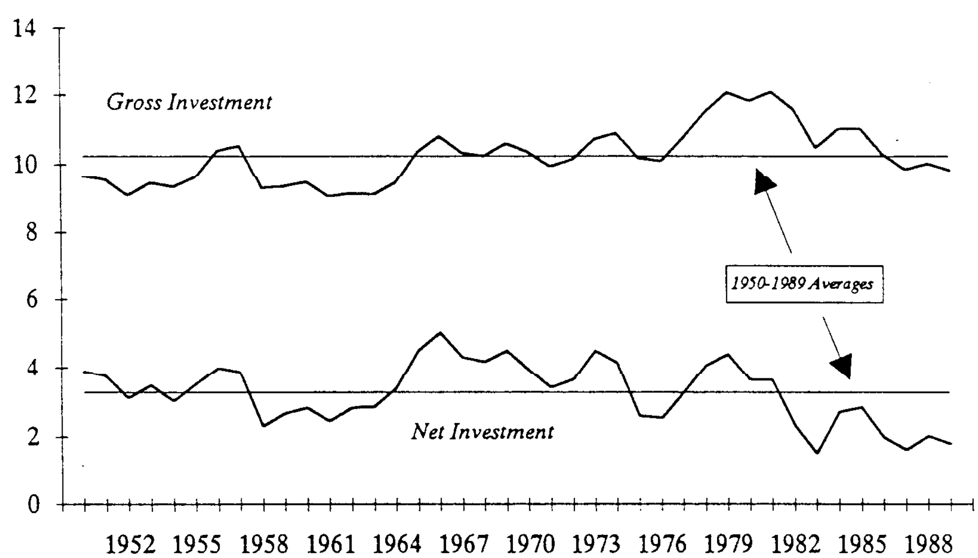
Introduction

An important element in the continuing debate over economic growth is the cost of capital or, in more prosaic terms, the before-tax rate of return which an investment must yield to be profitable. This return (referred to by economists as the "social rate of return") is determined by the interaction of the after-tax rate of return demanded by investors (the "private rate of return"), risk, inflation, and the tax system. The lower the cost of capital, the greater the number of investment projects that will be profitable. *Ceteris paribus*, a low cost of capital should yield a high rate of investment and will, in turn, foster economic growth. Consequently, an important goal of economic policy is to minimize the cost of capital consistent with other goals of revenue generation and tax equity and neutrality.

Chart 1. Gross and Net Investment in Plant and Equipment
(as percentages of GNP and NNP, respectively)



Concern over the cost of capital stems from a belief that our current rate of investment is too low. Chart 1 displays the annual ratios of gross and net investment in plant and equipment to, respectively, Gross National Product and Net National Product. Although the ratio of gross investment to GNP has only recently dipped below its postwar average, the ratio of net investment to NNP has been below average since 1981. Many analysts argue that the cost of capital in the United States is currently too high, and that this fact restricts our willingness to invest. That position is difficult to evaluate without empirical evidence. Convincing evidence is difficult to obtain and interpret, however, for at least three reasons. First, researchers have not been very successful in implementing empirical models of investment behavior (see, for instance, Ford and Poret, 1990) that can establish the relationship between the cost of capital and investment. Second, the cost of capital cannot be directly observed, a fact which may explain the difficulty in estimating investment equations. Finally, as a first step toward a better model of investment behavior, we need a more fully developed empirical framework. This framework is needed not only to measure the cost of capital, but also to assess whether it is artificially high due to controllable policies, or whether it reflects only market forces. To establish a starting point for addressing these issues, we present in this paper alternative, historical measures of the corporate cost of capital. By placing the current cost of capital within this historical context, we can better evaluate whether it is, in fact, currently high. At the same time, we provide an explicit framework for analyzing some of the factors that influence, directly, the cost of capital and, indirectly, the growth of the capital stock.

Assumptions and Procedures

Our method for estimating the cost of capital begins with a slightly modified version of the model of firm behavior presented in Auerbach (1983). We assume that the owners of the firm want to maximize the value of their equity holdings (cf. Gravelle, 1985). Assuming that the share of debt financing (λ) is constant over time, this reduces to the following maximization problem:

$$\begin{aligned}\max_{K} E = (1-\lambda)W = \int_0^{\infty} e^{-rt}\{&(1-\tau_c)p_t F(K_t) - (1-\lambda-k)q_t I_t - \lambda i_t(1-\tau_c)q_t K_t) + \\ &\lambda(\dot{q}_t/q_t - \delta)q_t K_t + \tau_c \int_{-\infty}^{t}(q_v I_v D_{t-v})\,dv - \tau_p q_t K_t\}\,dt\,, \qquad (1)\end{aligned}$$

subject to

$$\dot{K}_t = I_t - \delta K_t\,, \qquad (2)$$

where

$(1-\tau_c)p_t F(K_t)$ = after-tax revenue

$(1-\lambda)q_t I_t$ = shareholder cost of investment

$\lambda\, i_t\, (1-\tau_c)\, q_t\, K_t$ = after-tax interest cost

$k q_t I_t$ = valuc of investment tax credits

$\lambda(\dot{q}_t/q_t - \delta) q_t K_t$ = proceeds from maintaining the leverage rate at λ

$\tau_C \int_{-\infty}^{t} (q_v I_v D_{t-v})\, dv$ = tax deduction for depreciation

$\tau_p q_t K_t$ = property tax payments,

and the variables are defined as

r = discount rate
p_t = price of output
$F(K_t)$ = production function
q_t = price of capital
I_t = investment
k = investment tax credit percentage
τ_p = property tax rate.
τ_c = corporate tax rate
K_t = capital stock
W = value of the firm
δ = rate of depreciation in real service flow
i_t = interest rate on corporate debt
D_{t-v} = tax depreciation for vintage v capital

Substituting (2) into (1) and letting

$$z = \int_0^{\infty} (e^{-rv} D_v)\, dv, \tag{3}$$

yields

$$\max_K E = (1-\lambda) W = \int_0^{\infty} e^{-rt} \{(1-\tau_c) p_t F(K_t) - q_t (1 - k - \tau_c z - \lambda)(\dot{K}_t + \delta K_t) - \tau_p q_t K_t - \lambda(i_t(1-\tau_c) - \dot{q}_t/q_t + \delta) q_t K_t\} dt + \int_{-\infty}^{0} (q_v I_v D_{t-v})\, dv. \tag{4}$$

Solving equation (4) with respect to K_t and dropping subscripts yields the following expression for the service price of capital (s):

$$s = \frac{q}{p} \left[\frac{(1 - k - \tau_c z)}{(1-\tau_c)} \{r + \delta - \frac{\dot{q}}{q}\} - \frac{\lambda}{(1-\tau_c)} \{r - i(1-\tau_c)\} + \tau_p \right]. \tag{5}$$

In equilibrium, the service price of capital (alternatively called the rental cost or *user* cost of capital) equals the value of the marginal product of capital. By definition, the real cost of capital (ρ) is equal to the service price of capital, expressed as a proportion of the cost of the investment, less the depreciation rate, plus the real capital gain

$$\rho = \left[s\frac{p}{q} - \delta \right] + \left[\frac{\dot{q}}{q} - \pi \right], \tag{6}$$

where π is the rate of change in consumer prices. Equation (6) makes it clear that the return to the asset has two components, a rental return and a return based on changes in relative prices.

Equations (5) and (6) form the framework for our analysis. Most of the data required to estimate the cost of capital are straightforward, though detailed, and are displayed on an annual basis in Table 1. The choice of an optimal investment path does, however, require knowledge of or special assumptions about the real return to equity, the interest rate, and the rates of price change. To simplify implementation of our model, we assume that investors expect future rates of inflation and real rates of return to be constant (although the expected constant rates may change over time). To add additional structure to the model, we also break the discount rate down into its component parts of the investors' real, after-tax rate of return (r^*), the expected rate of inflation in consumer prices (π), and the post-corporate tax rate on equity returns (τ_e):

$$r = \frac{r^* + \pi}{1 - \tau_e}. \tag{7}$$

Discounting by r implies that the investor ultimately receives a real, after-tax return of r^*.

In this paper, we estimate service prices and the cost of capital under U. S. corporate tax rules over the time period from 1950 to 1988. Obviously, estimates of the service price and cost of capital can be sensitive to the assumptions on which they are based. First, and most important, we focus on *ex ante* measures; that is, we estimate, for example, the cost of capital in time t based on investors' expectations of the future values of variables used in the calculation. The *ex post* cost of capital is an equally valid measure. However, since our emphasis is on incentives to invest, our *ex ante* focus is appropriate. We also assume that three-quarters of corporate equity returns are distributed in the form of capital gains and that one-quarter is distributed as dividends. Under this assumption, τ_e is a weighted average of the capital gains and dividend tax rates. In addition, we adjust the capital gains tax rate to account for the value of deferral and the step-up of basis at death (*cf.* King and Fullerton, 1984). These assumptions can be easily varied, however, to incorporate alternative scenarios.

The most difficult component of the cost of capital to estimate is the discount rate r, which represents the investor's required, before-personal-tax rate of return. Although it is possible to measure the actual realized return to equity, there is no simple way to estimate the expected, or required, rate. The actual return to equity is a combination of dividend yield and capital gains. Capital gains, in turn, represent the effect on the value of the firm of both retained earnings and revaluations of the firm's future earning prospects. We have constructed two alternative measures of these returns for use in simulating capital costs. Both use actual dividends and retained earnings from the National Income and Product Accounts to measure these components of return. They differ, however, in how they estimate both the value of the firm and how the firm is revalued over time. One measures the return to equity value, using stock market valuations. The other measures the return to the net worth of the firm, using tangible and financial asset valuations from the Federal Reserve Board Flow of Funds Accounts. Table 2 presents time series for the components of these two measures, along with the total nominal and real rates of return.

As Table 2 demonstrates, the alternatives differ drastically, not only in their volatility, but also in the time pattern of returns. In the simulation below, we use the less volatile flow-of-funds series to construct a measure of r that allows for historical variation in the return to investment. In contrast, a number of earlier studies have used stock market measures to represent r in analyzing international differences in the cost of capital (*e. g.*, Bernheim and Shoven (1986, 1989) and McCauley and Zimmer (1989)). It is very difficult to interpret the results of studies that include either historical or international variation in the required return to equity. The question, essentially, is whether measured variations reflect true underlying differences. It is important to continue efforts to develop measures of the required return to equity, and the flow-of-funds measure used in this paper is instructive. Until we have a better understanding of such measures, however, their use in cost of capital estimation is problematic. Unfortunately, however, since historical variation in the rate of return to equity is related to historical variation in interest rates and inflation, it could be misleading to include only the latter variation in estimates of the cost of capital.

To evaluate the sensitivity of our measures and to partition changes in s and ρ into their components, we estimated equations (5) and (6) under a series of alternative assumptions about r^*, i, λ and expected inflation.

- First, in what we call a pure tax policy, equity investment simulation, we assume that $r^* = 4.0\%$, all prices are expected to change at 4.0% per year and λ is zero. This set of assumptions provides a simple baseline for an all equity investment, with the same expected profitability over time, abstracting from variation in anything but tax rates.

- The second simulation adds the effects of the tax treatment of leverage by assuming that investment is one-third debt financed ($\lambda = 1/3$) and that the real, after-tax rate of interest ($i_t (1 - \tau_i) - \pi$) is 4.0%, where τ_i is the effective marginal tax rate on interest income. This implements the "individual arbitrage" assumption discussed in Fullerton and Henderson (1984), and incorporates the advantages of financing investment through tax-deductible debt issue.

- The third simulation adds historical variation by allowing the interest rate and the expected inflation rate to vary over time. We use the AAA bond rate at the time of the investment as our measure of i. We assume that all prices are expected to grow at the same rate equal to the three-year forward average of the rate of change in the deflator for the Personal Consumption Expenditures (PCE) component of the National Income and Product Accounts. Note, however, that we adopt only one of many possible assumptions about inflationary expectations, and the results will be sensitive to how expectations are modeled.

- The fourth simulation allows for variation in expected relative prices and separately forecasts expected inflation in the PCE, equipment and structures price indexes, again using a three-year, prospective moving average.

- Finally, we allow historical variation in both the discount rate and the after-personal-tax rate of return on equity (r and r^*). To do this we estimate r as a three-year, prospective moving average of the estimate of the required rate of return to equity derived from the Flow of Funds Accounts. The expected after-tax rate of return, r^* is then derived using equation (7). The focus on the discount rate rather than the after-tax return to investors is consistent with the assumption of an open economy with free flow of capital (see Bovenberg, Andersson, Aramaki and Chand, 1989). As in the previous two simulations, the results are sensitive to the form assumed for the expectations process.

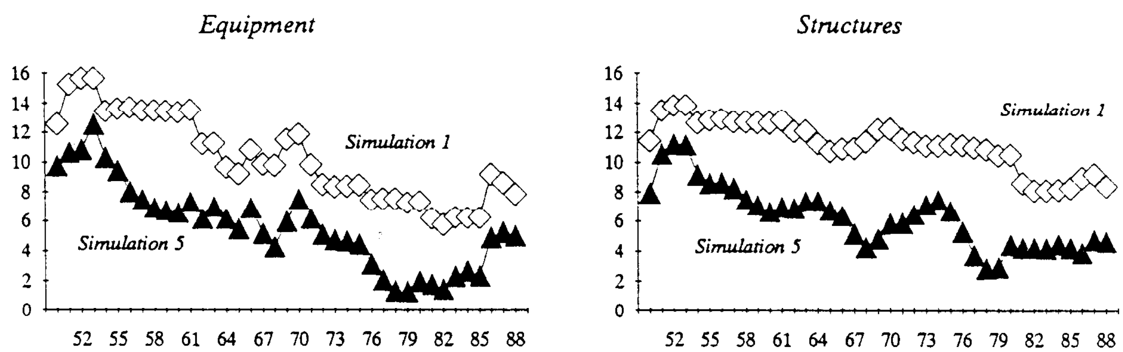
We prepared separate estimates for each of the 34 asset categories listed in the data appendix. Depreciation rules for 73 industries for each of the asset categories were drawn from historical Internal Revenue Service publications. Average tax lives were estimated for each asset category by averaging lives across industries. The industry categories and weights are from Gillingham and Greenlees (1987). We used the geometric economic depreciation rates estimated by Hulten and Wykoff (1981). As shown in Gillingham and Greenlees (1987), the substitution of nongeometric depreciation patterns has little impact on estimated historical trends in the cost of capital. Summary measures for equipment and structures were obtained using average capital stock weights for the 1950-1988 period, derived from Bureau of Economic Analysis capital stock series.

We tested whether the results would be sensitive to weighting by calculating chain-weighted Laspeyres, Paasche and Fisher Ideal indexes. The results were essentially identical.

Results

The historical pattern of the cost of capital under the five alternative sets of assumptions is given in Table 3. The table begins with the simplest scenario and sequentially incorporates additional complexities. Under each of the scenarios, the cost of capital trended down from the 1950's through the 1970's. This pattern resulted from downward trends in the corporate and dividend tax rates, as well as more liberal depreciation rules and the institution of investment tax credits. The picture for the 1980's is less clear, however. Despite the fact that the Economic Recovery Tax Act of 1981 and the Tax Reform Act of 1986 continued the decline in marginal tax rates, other parts of the Tax Reform Act of 1986 reversed the trend in the cost of capital, at least for equipment.

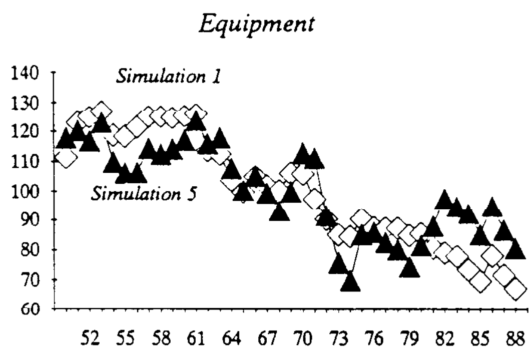
Chart 2. Alternative Measures of the Cost of Capital
(measured in percent)

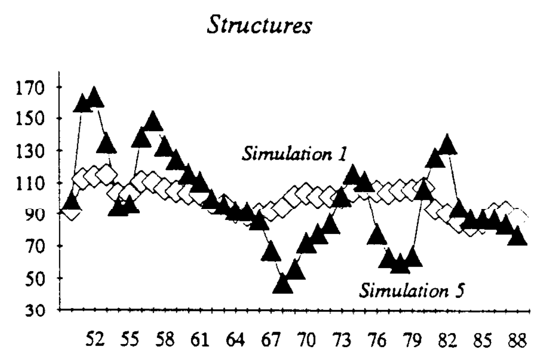


Although the scenarios in Table 3 present qualitatively similar pictures of historical trends in the cost of capital, Chart 2 demonstrates how they differ substantially in quantitative detail. Both simulations are based on *a priori* reasonable scenarios, and they represent only two of a myriad of reasonable scenarios. The fact they differ so much in detail demonstrates the difficulty in assessing how investment incentives vary over time. Simulation 1 focuses solely on tax policy. Simulation 5 differs from the pure tax policy case in a number of important ways. Two important examples are: (1) inclusion of the benefits of leverage lowers the estimated level of the cost of capital over the entire period, and (2) movements in the estimated required, after-tax rate of return to equity, especially during the 1950's and 1970's, alter the shape of the overall downward trend.

The cost of capital measures the net rate of return to investment and is therefore a determinant of the optimum size of the capital stock. By contrast, the required rental price of capital, defined in equation (5), equilibrates the supply of and demand for capital services and, consequently, the level of output. Simulations of the service price of capital for the same five scenarios are presented in Table 4. Each series is expressed as an index averaging 100 over the 1950 to 1988 period. Simulations 1 and 5 are also displayed in Chart 3. The series for equipment exhibit roughly the same trends, at least through the mid-1970's, as the cost of capital series. In contrast to the cost of capital, however, the simplest service price measure continues to fall into the 1980's, while the most complex measure increases, though erratically, starting in 1975. For structures, neither Simulation 1 nor Simulation 5 yields a clear trend, and the series in Simulation 5 is highly erratic.

Chart 3. Alternative Measures of the Service Price of Capital
(1950-1988 average = 100)





Conclusions

The results presented in this paper only scratch the surface of problems encountered in measuring and evaluating investment incentives. Caution is warranted not only because of the variations among our simulated historical series, but also because of the many maintained assumptions underlying each series. To give just two examples, the use of an alternative measure of the required equity return or a retrospective rather than prospective expectations process would yield substantially different estimates of the cost of capital and service price. In addition, even in the neoclassical model the rate of investment is not determined solely by contemporaneous values of the cost of capital. The lag in achieving the optimal capital stock adds another layer of timing over the expectations processes used in this paper. At this point, the safest conclusion we can draw is that one should not be surprised at the difficulty in developing a theoretically consistent, empirically verifiable model of investment.

Table 1: Component Series for Constructing the Cost of Capital

(Inflation rates are changes during year, all other variables are annual averages; all series measured in percent)

	Income Tax Rates				Property Tax Rates			Inflation Rates			
Year	Corporate	Dividend	Capital Gains	Interest	Equip.	Struct.	Public Utility	PCE	Equip.	Struct.	Nominal Interest
1950	42.0	43.6	16.5	25.8	0.5	1.1	0.5	5.8	7.6	9.2	2.6
1951	51.0	43.6	16.5	25.8	0.5	1.1	0.5	3.5	0.4	6.7	2.9
1952	52.0	43.6	16.5	25.8	0.6	1.2	0.5	2.5	3.8	-0.9	3.0
1953	52.0	43.6	16.5	25.8	0.6	1.2	0.5	0.9	2.0	2.1	3.2
1954	52.0	43.6	16.5	25.8	0.6	1.3	0.6	0.5	4.3	-2.1	2.9
1955	52.0	44.9	17.3	25.9	0.6	1.2	0.5	1.4	2.1	8.2	3.1
1956	52.0	45.5	17.4	26.8	0.6	1.3	0.6	3.2	9.8	7.4	3.4
1957	52.0	44.0	16.4	26.3	0.6	1.3	0.6	2.6	3.2	1.0	3.9
1958	52.0	43.7	16.4	25.9	0.6	1.4	0.6	1.4	2.5	-0.4	3.8
1959	52.0	43.1	16.8	25.5	0.7	1.4	0.6	2.2	1.3	1.4	4.4
1960	52.0	42.1	16.5	24.7	0.7	1.5	0.6	1.7	2.6	-1.0	4.4
1961	52.0	43.0	17.6	25.2	0.7	1.5	0.7	1.4	0.4	-0.2	4.3
1962	52.0	42.0	16.8	24.4	0.8	1.6	0.7	1.8	1.0	1.8	4.3
1963	52.0	42.2	16.7	24.1	0.8	1.6	0.7	1.8	-0.6	1.4	4.3
1964	50.0	38.0	16.5	21.1	0.8	1.7	0.7	1.4	0.0	1.7	4.4
1965	48.0	36.4	16.4	20.5	0.8	1.7	0.7	2.4	1.4	5.0	4.5
1966	48.0	36.9	15.8	20.8	0.8	1.6	0.7	3.0	3.7	4.9	5.1
1967	48.0	37.8	16.7	21.7	0.8	1.7	0.7	3.1	2.8	2.4	5.5
1968	48.0	42.0	18.9	24.9	0.8	1.7	0.8	4.6	3.8	7.1	6.2
1969	48.0	42.9	19.6	26.3	0.8	1.8	0.8	4.6	5.2	7.4	7.0
1970	48.0	40.5	18.8	26.4	0.9	1.9	0.8	4.6	3.2	7.1	8.0
1971	48.0	39.6	19.4	25.3	0.9	1.9	0.8	4.6	5.7	8.5	7.4
1972	48.0	38.8	20.1	25.2	0.9	1.8	0.8	3.9	0.5	5.9	7.2
1973	48.0	37.7	19.2	23.8	0.8	1.7	0.8	8.9	2.9	8.8	7.4
1974	48.0	39.8	18.4	26.6	0.7	1.5	0.7	10.0	16.6	17.5	8.6
1975	48.0	41.1	18.0	26.8	0.7	1.5	0.7	6.9	10.8	4.2	8.8
1976	48.0	41.3	19.4	27.0	0.7	1.5	0.6	5.5	6.7	6.4	8.4
1977	48.0	42.0	20.4	26.8	0.7	1.4	0.6	6.7	6.7	8.5	8.0
1978	48.0	42.9	20.6	27.9	0.6	1.2	0.5	8.2	7.0	11.9	8.7
1979	46.0	44.0	17.7	28.5	0.5	1.1	0.5	10.5	8.0	10.9	9.6
1980	46.0	45.1	18.0	30.4	0.5	1.0	0.5	10.5	9.8	9.9	11.9
1981	46.0	43.3	17.3	31.9	0.5	1.0	0.5	7.4	8.4	12.2	14.2
1982	46.0	37.3	15.9	28.2	0.5	1.1	0.5	4.6	3.7	0.6	13.8
1983	46.0	35.3	15.2	25.6	0.6	1.2	0.5	4.0	-2.2	-2.4	12.0
1984	46.0	34.1	15.1	25.8	0.6	1.2	0.5	3.3	-2.4	3.8	12.7
1985	46.0	33.6	15.4	25.2	0.6	1.3	0.6	3.2	-1.6	4.0	11.4
1986	46.0	34.6	16.3	25.6	0.6	1.3	0.6	3.0	0.9	3.5	9.0
1987	40.0	27.8	26.3	23.2	0.6	1.3	0.6	4.7	-3.5	3.3	9.4
1988	34.0	24.8	27.3	22.1	0.6	1.4	0.6	4.2	2.6	6.1	9.7
1950-88	48.2	40.2	17.9	25.5	0.7	1.4	0.6	4.2	3.6	5.0	6.9
1950's	50.9	43.9	16.7	26.0	0.6	1.2	0.5	2.4	3.7	3.3	3.3
1960's	49.8	40.3	17.2	23.4	0.8	1.6	0.7	2.6	2.0	3.1	5.0
1970's	47.8	40.8	19.2	26.4	0.7	1.6	0.7	7.0	6.8	9.0	8.2
1980-88	44.0	35.1	18.5	26.4	0.6	1.2	0.5	5.0	1.8	4.6	11.6

Table 2: Alternative Measures of the Rate of Return to Equity

	Equity Market Rates of Return					Tangible Capital Market Rates of Return				
Year	Dividends	Retained Earnings	Market Reval.	Nominal Return	Real Return	Dividends	Retained Earnings	Market Reval.	Nominal Return	Real Return
1950	7.5	6.3	16.6	32.3	25.1	3.4	2.8	5.7	12.0	5.8
1951	5.7	5.0	8.0	19.6	15.6	2.9	2.6	5.3	10.8	7.1
1952	5.0	4.8	3.6	13.8	11.1	2.7	2.6	2.7	7.9	5.3
1953	5.1	4.0	-5.3	3.5	2.6	2.6	2.1	2.2	6.9	5.9
1954	4.3	4.0	31.8	42.2	41.4	2.5	2.4	2.4	7.3	6.7
1955	3.5	4.8	21.6	31.3	29.6	2.7	3.6	5.1	11.4	9.9
1956	3.3	3.3	-2.3	4.2	1.0	2.6	2.6	7.1	12.3	8.8
1957	3.6	3.3	-12.6	-6.3	-8.7	2.5	2.3	3.9	8.6	5.9
1958	3.3	2.4	27.3	34.2	32.3	2.3	1.7	2.3	6.4	4.9
1959	2.9	3.3	2.2	8.5	6.2	2.4	2.8	2.5	7.7	5.4
1960	3.0	2.7	0.2	5.9	4.2	2.5	2.2	0.7	5.3	3.6
1961	2.8	2.6	15.7	21.8	20.2	2.4	2.3	1.2	5.9	4.5
1962	2.8	3.8	-14.8	-8.8	-10.4	2.5	3.4	0.3	6.2	4.4
1963	3.0	4.2	15.2	23.3	21.2	2.7	3.8	0.8	7.2	5.4
1964	2.9	4.6	8.5	16.4	14.8	2.8	4.5	1.7	9.0	7.4
1965	3.0	5.0	1.8	10.1	7.5	3.1	5.2	2.0	10.3	7.7
1966	3.2	5.3	-14.0	-6.3	-9.0	3.1	5.1	2.6	10.8	7.5
1967	3.1	4.5	6.5	14.5	11.1	3.0	4.3	2.3	9.7	6.4
1968	2.8	3.2	7.1	13.5	8.6	3.1	3.6	4.2	10.9	6.0
1969	2.8	2.5	-13.6	-8.8	-12.8	2.8	2.5	4.6	10.0	5.2
1970	2.9	1.5	-2.6	1.8	-2.7	2.5	1.3	4.4	8.2	3.4
1971	2.7	2.4	7.3	12.7	7.8	2.3	2.1	5.0	9.4	4.7
1972	2.5	2.7	10.2	15.9	11.5	2.3	2.5	4.6	9.4	5.3
1973	2.8	2.8	-16.2	-11.3	-18.5	2.2	2.2	8.4	12.8	3.7
1974	3.8	0.9	-27.3	-23.6	-30.4	1.9	0.5	20.7	23.1	12.0
1975	4.4	4.4	20.9	31.2	22.8	1.8	1.8	7.5	11.1	4.0
1976	3.8	4.5	3.4	12.0	6.2	1.8	2.1	6.3	10.3	4.6
1977	4.2	5.7	-15.5	-6.6	-12.4	1.9	2.6	7.0	11.5	4.5
1978	5.0	5.6	1.3	12.2	3.8	2.0	2.2	10.7	14.8	6.2
1979	4.7	3.6	5.7	14.6	3.8	1.8	1.4	8.5	11.7	1.2
1980	4.2	1.0	20.9	26.8	14.9	1.8	0.4	10.0	12.2	1.7
1981	4.3	2.2	-12.8	-6.9	-13.2	1.9	0.9	9.9	12.7	5.1
1982	4.6	0.5	18.4	24.3	18.8	1.9	0.2	2.9	5.0	0.4
1983	4.6	2.6	11.1	19.1	14.5	2.1	1.2	0.9	4.3	0.3
1984	4.3	5.0	-0.2	9.3	5.8	2.1	2.4	3.0	7.6	4.1
1985	4.0	4.7	16.0	25.9	22.1	2.2	2.5	2.1	6.7	3.5
1986	3.6	3.1	21.0	28.7	24.9	2.2	1.9	3.7	7.8	4.6
1987	3.5	2.2	-5.7	-0.2	-4.6	2.3	1.4	3.9	7.7	2.9
1988	3.4	2.5	7.4	13.7	9.1	2.3	1.7	4.6	8.6	4.3
1950-88	3.8	3.5	3.4	10.9	6.5	2.4	2.4	4.7	9.5	5.1
1950's	4.4	4.1	8.2	17.4	14.6	2.7	2.5	3.9	9.1	6.6
1960's	2.9	3.8	0.6	7.5	4.8	2.8	3.7	2.0	8.5	5.8
1970's	3.7	3.4	-2.3	4.8	-2.0	2.1	1.9	8.3	12.2	5.0
1980-88	4.1	2.5	1.1	7.5	2.7	2.1	1.4	4.6	8.1	3.0

Table 3. Alternative Measures of the Cost of Capital

	Basic Cost of Capital (Scenario 1)		Leverage Adjustment (Scenario 2)		Infl. & Int. Rate Adj. (Scenario 3)		Rel. Price Adjustment (Scenario 4)		IRR Adjustment (Scenario 5)	
Year	Equipment	Structures	Equipment	Structures	Equipment	Structures	Equipment	Structures	Equipment	Structures
1950	12.6	11.4	10.5	9.4	7.8	6.8	7.7	6.0	9.8	8.0
1951	15.3	13.5	12.2	10.4	9.1	8.0	8.8	8.7	10.7	10.6
1952	15.7	13.8	12.4	10.6	9.1	8.3	8.5	8.8	10.9	11.2
1953	15.7	13.9	12.5	10.7	9.2	8.4	8.3	7.1	12.5	11.2
1954	13.4	12.6	10.2	9.4	7.4	7.1	6.5	5.2	10.4	9.2
1955	13.6	12.8	10.3	9.5	7.6	7.2	6.7	5.8	9.5	8.6
1956	13.7	12.9	10.4	9.6	7.8	7.3	7.2	7.7	8.1	8.7
1957	13.5	12.7	10.3	9.5	7.8	7.4	7.7	8.5	7.5	8.3
1958	13.5	12.7	10.3	9.5	7.7	7.4	7.7	8.4	6.9	7.5
1959	13.5	12.7	10.2	9.5	7.9	7.6	8.0	8.5	6.8	7.1
1960	13.4	12.6	10.2	9.4	7.9	7.7	8.1	8.3	6.6	6.7
1961	13.5	12.8	10.3	9.6	8.0	7.8	8.4	8.1	7.3	7.0
1962	11.2	12.1	8.0	8.8	6.0	7.1	6.2	7.0	6.2	6.9
1963	11.3	12.1	8.0	8.9	6.0	7.1	6.2	6.5	7.0	7.4
1964	9.7	11.3	6.7	8.3	4.9	6.7	4.9	6.0	6.2	7.4
1965	9.2	10.8	6.5	8.1	4.7	6.4	4.7	5.9	5.5	6.8
1966	10.8	10.9	8.1	8.2	6.5	6.6	6.5	6.0	6.9	6.5
1967	9.9	11.0	7.2	8.3	5.6	6.6	5.6	5.7	5.2	5.2
1968	9.8	11.4	7.1	8.7	5.5	7.0	5.5	5.6	4.3	4.3
1969	11.5	12.2	8.9	9.5	7.5	8.1	7.6	6.5	6.0	4.9
1970	11.9	12.2	9.3	9.7	8.2	8.5	8.7	7.1	7.5	5.9
1971	9.8	11.6	7.2	9.0	5.7	7.2	6.3	6.0	6.2	5.9
1972	8.5	11.3	5.9	8.8	4.1	6.5	4.1	5.2	5.1	6.5
1973	8.3	11.1	5.7	8.5	3.9	6.3	3.5	5.5	4.8	7.2
1974	8.4	11.1	5.8	8.6	4.5	7.0	4.0	6.5	4.7	7.5
1975	8.5	11.2	5.9	8.7	4.7	7.3	4.6	7.0	4.5	6.7
1976	7.4	11.2	4.9	8.6	3.4	6.9	3.5	5.8	3.1	5.3
1977	7.5	11.0	4.9	8.4	3.1	6.2	3.2	5.3	2.1	3.8
1978	7.5	10.9	4.9	8.3	3.1	6.0	3.3	5.4	1.4	2.9
1979	7.3	10.5	4.9	8.1	3.5	6.4	3.6	5.9	1.3	3.0
1980	7.3	10.5	5.0	8.2	4.6	7.6	4.7	8.0	2.0	4.5
1981	6.2	8.6	4.1	6.5	4.4	6.8	4.5	7.4	1.8	4.3
1982	5.8	8.1	3.7	6.0	4.3	6.7	4.3	7.3	1.5	4.3
1983	6.3	8.1	4.1	6.0	4.5	6.4	4.6	6.5	2.3	4.2
1984	6.2	8.2	4.1	6.0	4.7	6.6	4.7	6.6	2.7	4.5
1985	6.2	8.3	4.1	6.1	4.2	6.3	4.3	6.3	2.4	4.3
1986	9.2	9.0	7.0	6.8	6.3	6.0	7.1	6.0	4.9	4.0
1987	8.6	9.2	7.0	7.6	6.4	7.0	7.0	6.7	5.3	4.8
1988	7.9	8.4	6.7	7.2	6.2	6.8	6.6	6.3	5.0	4.7
1950-88	10.2	11.2	7.6	8.5	6.0	7.1	6.0	6.7	5.7	6.3
1950's	14.0	12.9	10.9	9.8	8.1	7.6	7.7	7.5	9.3	9.0
1960's	11.0	11.7	8.1	8.8	6.2	7.1	6.4	6.6	6.1	6.3
1970's	8.5	11.2	6.0	8.6	4.4	6.8	4.5	6.0	4.1	5.5
1980-88	7.1	8.7	5.1	6.7	5.1	6.7	5.3	6.8	3.1	4.4

Table 4. Alternative Measures of the Service Price of Capital

	Basic Cost of Capital (Scenario 1)		Leverage Adjustment (Scenario 2)		Infl. & Int. Rate Adj. (Scenario 3)		Rel. Price Adjustment (Scenario 4)		IRR Adjustment (Scenario 5)	
Year	Equipment	Structures	Equipment	Structures	Equipment	Structures	Equipment	Structures	Equipment	Structures
1950	111.3	92.5	115.4	97.6	111.0	87.9	107.0	75.8	118.0	99.4
1951	123.0	112.7	123.7	112.7	118.1	106.0	110.0	133.8	120.3	160.5
1952	125.0	114.1	125.3	113.5	118.9	107.4	104.4	132.7	116.9	164.9
1953	126.8	115.3	127.1	114.7	120.7	109.4	101.1	86.5	123.2	135.3
1954	118.8	103.5	117.9	101.2	112.9	93.8	89.4	51.5	109.8	95.6
1955	118.4	103.1	117.3	100.5	112.7	93.4	91.7	64.8	106.4	97.4
1956	121.6	110.9	120.6	108.4	116.3	101.2	101.1	122.8	106.6	139.2
1957	125.2	110.6	124.3	108.2	120.7	103.3	114.4	144.6	114.6	149.3
1958	125.2	106.8	124.3	104.4	120.5	99.8	115.5	135.9	112.6	133.3
1959	124.7	104.9	123.8	102.6	121.1	100.1	119.7	133.1	114.3	125.4
1960	125.5	103.7	124.5	101.3	122.1	99.5	124.4	127.3	117.4	116.4
1961	126.1	103.1	125.1	100.9	122.4	98.6	128.3	116.5	124.1	111.3
1962	113.8	96.8	111.7	93.6	109.7	91.5	115.2	96.5	116.1	100.6
1963	112.5	96.7	110.3	93.4	108.3	90.8	113.0	84.2	118.1	96.6
1964	104.0	91.4	102.4	89.2	101.0	87.6	100.5	75.8	107.9	93.3
1965	99.8	89.3	99.2	88.5	98.0	85.9	95.7	80.0	100.6	92.6
1966	105.2	91.3	105.5	90.7	105.6	88.9	102.3	78.4	105.6	87.1
1967	101.9	92.2	101.7	91.7	101.6	89.2	100.8	69.5	99.7	68.1
1968	100.4	94.6	100.0	94.5	100.1	92.8	98.4	59.1	93.4	48.3
1969	106.1	102.2	106.7	103.6	108.6	104.9	106.6	70.8	100.1	56.8
1970	106.0	104.0	107.3	106.2	110.6	110.0	117.2	81.8	112.9	72.9
1971	97.4	101.8	97.5	102.8	98.0	100.3	110.9	75.9	111.4	78.5
1972	90.5	101.9	90.0	102.7	88.4	95.6	86.0	67.0	91.8	84.8
1973	85.3	101.5	84.7	101.8	83.4	94.6	69.7	80.5	75.9	102.8
1974	84.6	105.4	84.4	106.3	85.3	105.1	66.3	100.5	70.1	116.6
1975	90.4	106.9	90.0	107.7	91.8	108.7	85.3	109.4	85.4	112.0
1976	87.5	105.2	86.6	105.8	86.5	103.1	86.8	79.9	86.2	78.7
1977	87.4	104.4	86.3	104.3	84.4	96.4	87.2	77.6	82.8	64.0
1978	87.4	106.3	86.4	106.1	84.7	97.6	88.5	86.5	80.4	60.8
1979	85.1	106.3	85.1	107.9	85.3	104.5	84.1	96.2	74.7	64.7
1980	85.6	107.5	85.9	109.7	90.8	118.7	93.2	144.5	81.7	107.1
1981	80.6	94.0	81.1	94.3	89.4	111.2	99.4	158.7	88.2	127.1
1982	79.2	91.3	79.6	91.1	89.1	111.3	109.2	166.8	97.5	135.5
1983	77.8	85.5	78.2	84.7	86.2	101.4	103.9	117.1	94.9	95.3
1984	73.6	83.4	74.0	83.1	82.3	100.8	100.1	107.1	92.6	88.1
1985	69.7	85.4	70.1	85.2	76.2	98.6	92.1	106.9	85.4	88.4
1986	78.2	91.9	79.7	92.6	83.0	97.3	102.6	107.9	95.0	88.0
1987	71.7	93.0	74.7	98.9	78.7	107.0	92.5	102.2	87.0	84.9
1988	67.2	88.5	71.4	97.5	75.5	105.9	85.4	93.7	80.7	78.3
1950-88	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1950's	122.0	107.5	122.0	106.4	117.3	100.2	105.4	108.2	114.3	130.0
1960's	109.5	96.1	108.7	94.7	107.7	93.0	108.5	85.8	108.3	87.1
1970's	90.1	104.4	89.8	105.2	89.8	101.6	88.2	85.5	87.1	83.6
1980-88	76.0	91.2	77.2	93.0	83.5	105.8	97.6	122.8	89.2	99.2

Data Appendix

Sources

The data used to implement the above model come from a variety of sources:

r_e: Required, real, after-tax rate of return on equity, specified by assumption or estimated from capital market rates of return.

τ_c: Maximum federal tax rate on corporate income.

q: National Income and Products Accounts (NIPA) deflator for equipment or structures investment. The annual rate of change in q is either assumed constant or an expectation is constructed from the NIPA time series.

i: Corporate borrowing rate, either derived from assumptions about the real, after-tax rate of return to bondholders, or measured as the AAA corporate bond rate from Citibank Data Base.

δ: Geometric rate of depreciation in real service flow of capital stock from Hulten and Wykoff (1981).

k: Investment tax credit.

τ_p: Average property tax rate for equipment, structures, and public utility property, estimated by allocating total property taxes by source using information from NIPA and Harriss (1974), and dividing by value of capital stock as estimated by the Bureau of Economic Analysis (BEA).

τ_e: Marginal individual tax rate on equity, computed as a weighted average of the tax rates on capital gains and dividends. The tax rate series were derived from data and methods used in Congressional Budget Office (1988).

τ_i: Marginal individual tax rate on interest, estimated using data and methods from Congressional Budget Office (1988), as for τ_e.

π: Expected annual rate of increase in consumer prices, specified by assumption or estimated from the deflator for Personal Consumption Expenditures.

Asset Categories

Service price and cost of capital series were calculated for each of the following asset categories:

1	Furniture and Fixtures
2	Fabricated Metal Products
3	Engines and Turbines
4	Tractors
5	Agricultural Machinery, except Tractors
6	Construction Machinery, except Tractors
7	Mining and Oilfield Machinery
8	Metalworking Machinery
9	Special Industry Machinery, n. e. c.
10	General Industrial, Including Materials Handling, Equipment
11	Office, Computing, and Accounting Machinery
12	Service Industry Machinery
13	Communication Equipment
14	Electrical Transmission, Distibution, and Industrical Apparatus
15	Electrical Equipment, n. e. c.
16	Trucks, Buses, and Truck Trailers
17	Autos
18	Aircraft
19	Ships and Boats
20	Railroad Equipment
21	Instruments, and Photocopy and Related Equipment
22	Other Equipment
23	Industrial Buildings
24	Commercial Buildings
25	Hospital and Institutional Buildings
26	Other Nonfarm Buildings
27	Telephone and Telegraph Structures
28	Electric Light and Power Structures
29	Gas Structures
30	Railroad Structures
31	Other Public Utility Structures
32	Farm Structures
33	Mining Exploration, Shafts, and Wells
34	Other Structures

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